CHAPTER 5

MONITORING AND ADAPTIVE MANAGEMENT

"Keeping Today's Wildlife from
Becoming Tomorrow's Memory"

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Introduction

Monitoring Delaware's SGCN, their habitats, and the effectiveness of the conservation actions identified in the previous chapters will provide information for DE DNREC DFW and its partners to measure success of the DEWAP (Element 5). Monitoring will help determine the effectiveness of conservation actions, ensuring the most efficient use of limited staffing and funds, and will reduce or eliminate threats facing the state's fish and wildlife resources. As conditions change (e.g., land use patterns, climate change, global or national population trends, new data and information), adaptive management and implementation of the conservation actions identified in Chapter 4 will allow DE DNREC DFW to respond appropriately. Adaptive management has received ample attention in the conservation community as an effective method for long-term conservation (e.g., Johnson and Case 2000, TNC 2000, Brown et al. 2001, Groves et al. 2002, Pew Oceans Commission 2003, USFWS 2004, and Salafsky et al. 2001, 2002, and 2003).

The DEWAP is strategic in nature and presents a monitoring and adaptive management framework that will be used to assess the status of SGCN and habitats as well as monitor the effectiveness of conservation actions. Delaware's approach identifies existing monitoring efforts and tools currently used by DE DNREC DFW and partners to assess SGCN, key habitats and related issues, as listed in the plans and programs in Appendix 5. If monitoring is not identified for an SGCN or species group/taxa, Chapter 4 of this SWAP describes monitoring actions for other species which occupy the same habitats or for the habitats themselves. In cases where not enough information exists to monitor a species or group, or for which monitoring protocols have not yet been developed, this need is documented and followed by a conservation action intended to address that need. In cases where standardized protocols need to be developed and baseline data do not exist to form the basis of a monitoring protocol, these needs are described in Chapter 1 under the appropriate taxa. As the information gaps are filled, any relevant monitoring can be adapted to be more quantitative and specific (Holling 1978). When possible standard protocols will be used, but where new monitoring protocols are needed, Oakley et al. (2003) provides guidelines on how to develop them.

This chapter reveals how Delaware will use tools for information management and conservation planning to monitor the implementation and effectiveness of conservation actions. These tools include the Northeast Regional Monitoring and Performance Reporting Framework collaboratively funded by the National Fish and Wildlife Foundation (NFWF, see NEAFWA 2008) and its successors, the State Wildlife Grants Effectiveness Measures Project (AFWA 2012) funded by the Doris Duke Foundation, the Northeast Lexicon Project (Crisfield and NEFWDTC 2013), and the national Wildlife

Tracking and Reporting Actions for the Conservation of Species (*Wildlife TRACS*) database funded by USFWS. The framework starts with a specific conservation action, then a basic results chain is created linking the action to relevant issues, habitats and species. Next, indicators and measures are selected for each step in the chain, and monitoring data are used to track those indicators. Measurement of these indicators over time will provide the essential information needed for evaluating the effectiveness of each conservation action.

Regional Coordination and Context

The development of regional monitoring activities remains a high priority for the Northeast Fish and Wildlife Diversity Technical Committee (NEFWDTC) due to the large number of shared priority species and habitats, the relatively limited funding available in any one state for monitoring, and the presence of many regional experts who have knowledge of particular taxa or ecosystems. NEFWDTC planning efforts have led to several key monitoring projects funded by the RCN Grant Program.

The Monitoring and Performance Reporting Framework

The NEAFWA Monitoring and Performance Reporting Framework (NEAFWA 2008) is intended to help each state in the Northeast to meet the expectations set by Congress and the USFWS for the SWAPs and the SWG programs. The goal of this framework is to assess the status and trends of SGCN and their habitats and to evaluate the effectiveness of activities intended to conserve species and habitats across the Northeast. For more information and to review project reports, please visit: *http://rcngrants.org/content/regional-monitoring-and-performance-framework.*

The NEAFWA monitoring framework identified eight conservation targets defined as species, landscape features, or vegetation communities important to fish and wildlife: forests, freshwater streams and river systems, freshwater wetlands, highly migratory species, lakes and ponds, managed grasslands and shrublands, regionally significant SGCN, and unique habitats in the Northeast. Each of these targets is discussed under the appropriate chapter for species and habitats. For each target, key issues were identified, along with conservation actions that could help alleviate or eliminate the effects of that particular stressor. Indicators were proposed for tracking status and trends of each of the targets, and data sources were identified for each of the indicators

(NEAFWA 2008). Table 5-1 excerpted from NEAFWA (2008) lists the indicators and issues that were selected by workshop participants for each of the eight conservation targets.

Table 5. 1 List of Northeast Conservation Targets and Proposed Indicators

Targets	Proposed Indicators
1. Forests	1a. Forest area - by forest type
	1b. Forest area - by reserve status
	2. Forest composition and structure - by seral stage
	3. Forest fragmentation index
	4. Forest bird population trends
	5. Acid deposition index
2. Freshwater streams and river systems	1. Percent (%) impervious surface
	2. Distribution and population status of native Eastern Brook Trout
	3. Stream connectivity (length of open river) and number of blockages
	4. Index of biotic integrity
	5. Distribution and population status of non-indigenous aquatic species
3. Freshwater wetlands	1. Size/area of freshwater wetlands
	2. % impervious surface flow
	3. Buffer area and condition (buffer index)
	4a. Hydrology - upstream surface water retention
	4b. Hydrology - high and low stream
	5. Wetland bird population trends
	6. Road density
4. Highly migratory species	1. Migratory raptor population index

	2. Shorebird abundance
	3. Bat population trends
	4. Abundance of diadromous fish
	5. Presence of Monarch Butterfly
5. Lakes and ponds	1. % impervious surface/landscape integrity
	2. % shoreline developed (shoreline integrity)
	3. Overall Productivity (of Key Species)
6. Managed grasslands and shrublands	To be developed
7. Regionally Significant Species of Greatest Conservation Need	1. Population trends and reproductive productivity of federally listed species
	2. State-listing status and heritage rank of highly imperiled wildlife
	3. Population trends of endemic species
8. Unique habitats in the Northeast	1. Proximity to human activity/roads
	2. Wildlife presence/absence
	3. Wildlife population trends
	4. Land use/land cover changes

: NEAFWA 2008

Conservation Status of Northeast Fish, Wildlife, and Natural Habitats

Using the indicators developed at the regional level, NEAFWA supported The Nature Conservancy to assess the current condition of species and habitats in the Northeast through the Conservation

Status Project. This project used a GIS analysis to examine the relationship between species and habitat condition and land ownership and conservation management status. The original assessment project merged with another RCN-funded project, titled *Regional Indicators and Measures: Beyond Conservation Land* (Anderson and Olivero Sheldon 2011), which measured approximately 30 indicators of habitat condition and species and ecosystem health in the northeastern states. Together these projects, completed in September 2011, implemented approximately 75% of the Northeast Regional Monitoring and Performance Measures Framework (NEAFWA 2008), previously funded by the NFWF and the RCN Grant Program. Please see: *http://www.rcngrants.org/sites/default/files/final_reports/Conservation-Status-of-Fish-Wildlife-and-Natural-Habitats.pdf.*

State Wildlife Grants Effectiveness Measures Project

Building on the success of the Northeastern Regional Monitoring and Performance Measures Framework (NEAFWA 2008), the AFWA led an effort to develop an approach for measuring the effectiveness of wildlife conservation activities funded under the USFWS's SWG program. In September 2009, AFWA's Teaming with Wildlife Committee formed the Effectiveness Measures Working Group. This working group included representatives from state fish and wildlife agencies as well as private, academic, and non-governmental conservation partners with expertise in wildlife conservation and performance management.

In April 2011, the working group released a final report that outlines a comprehensive approach to measure the effectiveness of the activities funded under the SWG program. The report builds on the monitoring framework that was originally developed in the northeastern states and recommends a set of common indicators for measuring status, trends, and/or effectiveness of thirteen general types of conservation actions that are commonly supported by SWG. These actions include direct management of natural resources, species restoration, creation of new habitat, acquisition/easement/lease, conservation area designation, environmental review, management planning, land use planning, training and technical assistance, data collection and analysis, education, conservation incentives, and stakeholder involvement. The report includes sample templates and forms that could be used for reporting the results of conservation activities, as well as a discussion of the specific methods by which these reporting methods could be incorporated into the USFWS's grants management database. For more information and to review the project final report, please visit: *http://www.fishwildlife.org/files/Effectiveness-Measures-Report_2011.pdf*.

Wildlife TRACS Database

The State Wildlife Grants Effectiveness Measures Project has informed the development of *Wildlife TRACS*, a database designed by the USFWS to record information about conservation activities funded through the Wildlife and Sport Fish Restoration Program, including SWG. When fully functional, *Wildlife TRACS* is intended to track and report project outputs, effectiveness measures, and species and habitat outcomes. *Wildlife TRACS* has the potential to track long-term outcomes for species and habitats, above and beyond the types of short-term output measures commonly tracked by funding agencies (e.g., number of publications, number of workshops, number of people contacted). Because it is being designed to be responsive to the needs of the state agencies receiving SWG funding, *Wildlife TRACS* includes its own customized classifications of conservation actions and issues. These classifications are based, at least in part, on the classifications developed jointly by the IUCN and the Conservation Measures Partnership (CMP, see Salafsky et al. 2008). For more information about the development of *Wildlife TRACS*, please visit:
http://wsfrprograms.fws.gov/Subpages/TRACS/TRACS.html.

Northeast Lexicon for Common Planning and State Wildlife Action Plan Database

Wildlife conservation planners in the Northeast have long recognized a potential ambiguity in many of the terms that are used to describe fish and wildlife conservation activities. For example, a "target" may refer to a number, an area, a specific site, a species, a group or guild of species, a vegetation community, or an ecosystem type. There is an acute need to develop a standard lexicon that provides conservationists with a uniform terminology that accurately and adequately describes the work of state fish and wildlife agencies. Although lexicons have been developed by the IUCN and the CMP, they are designed primarily for international conservation and sustainable development projects, activities that differ in many important ways from fish and wildlife conservation activities in the northeastern states. Thus, the NEFWDTC is developing a regional conservation lexicon that can be used by state wildlife agencies and partners to describe their conservation projects (Crisfield and NEFWDTC 2013).

The *Northeast SWAP Database* is a data management tool developed by Kevin Kalasz, Karen Terwilliger, and Jonathan Mawdsley that provides a basic structure for storing and querying data collected by the individual states as part of their SWAP revisions. The database includes full support for results chains as well as indicators and the AFWA SWG Effectiveness Measures.

Region-wide Taxa-specific Surveys and Monitoring

There are numerous taxa-specific surveys, inventory, or monitoring programs that have been developed and implemented with NEAFWA's support and through other regional collaborations. With RCN funding, surveys and assessments have been conducted or are in the process of being conducted for Wood Turtle, Eastern Black Rail, odonates (dragonflies and damselflies), New England Cottontail (Fuller and Tur 2012), shrubland birds (McDowell 2011), aquatic habitats (Gawler 2008), and frogs. Detailed avian indicators have also been developed for assessing the magnitude of issues and the effectiveness of conservation measures (Northeast Coordinated Bird Monitoring Partnership 2007). An online database of museum specimen records for SGCN invertebrates in the Northeast was developed by Fetzner (2011). More in-depth reports describing the methods and results of these surveys and associated data products are available at the RCN website: *http://www.rcngrants.org*.

Regional Monitoring Protocols and Databases

Northeast states have also developed monitoring protocols and databases through regional multi-state collaborative efforts. With funding from the RCN Grant Program, monitoring protocols have been developed, reviewed, or revised for several species of regional conservation interest, including New England Cottontail (Fuller and Tur 2012), shrubland-dependent birds (McDowell 2011), freshwater aquatic habitats (Gawler 2008), and frogs. Ongoing RCN projects are also developing monitoring protocols for Wood Turtle, Eastern Black Rail, and odonates (dragonflies and damselflies). The consistent and widespread use of common monitoring methodologies and survey protocols will help support regional assessments of the status and trends of SGCN and their habitats. In addition, NEAFWA has also funded development of a database for regional invertebrate species of greatest conservation need through a partnership with the Carnegie Museum of Natural History in Pittsburgh (Fetzner 2011). A more comprehensive database has been proposed that would include data on all species, habitats, actions, and issues from the individual SWAPs in the Northeast; for introductory information and a lexicon of terms that would be used in such a database see Crisfield and NEFWDTC 2013. Links to monitoring plans and tools developed through the RCN Grant Program are available on the web site.

Delaware's Species and Habitat Monitoring Programs

Delaware is blessed with a wealth of monitoring programs that provide important information about wildlife species and their habitats. The following tables of wildlife species and habitat monitoring programs in Delaware were originally developed for the first edition of the DEWAP. They have been updated and enhanced based on information provided during the process of revising the DEWAP. The tables list individual monitoring programs, the associated organization(s) with each program, and the type and level of monitoring, whether single-species, guild-focused, or habitat-focused. Data from these programs and process-related information from individual implementation projects (e.g., number of meetings held, number of reports produced, number of people contacted through outreach efforts, number of plans developed, etc.) will be reported to the USFWS and tracked using the *Wildlife TRACS* database.

A key part of adaptive management is the determination of specific management objectives for SGCN, key habitats and abatement of threats from conservation issues. These would take the form of population levels for SGCN, areal extent and dispersion for key habitats, and maximum limits for impacts from "direct threat" conservation issues. Such objectives are often difficult to determine given the complexity of most natural systems, and they are beyond the scope of this Plan. However, population objectives are available for some species in regional and national conservation initiatives (e.g., Partners in Flight and endangered species recovery plans), and there is extensive literature on population viability analysis that can be applied to other species. Habitat objectives are less well developed, although there is a growing body of knowledge about patch size and isolation, connectivity, edge effects and similar factors that influence habitat viability. Some thresholds for impacts are well established, while others are poorly understood and require additional research.

Species Monitoring

Delaware has numerous monitoring programs already in place that monitor individual wildlife species as well as important species guilds such as shorebirds or waterfowl and diadromous fish (Appendix 5). These existing programs will be the primary method for monitoring and tracking species identified as SGCN in the current revision of the DEWAP. Data from these programs are collected and reported to the relevant wildlife managers at the state and federal level, in order to provide information that can be used for adaptively managing these important wildlife populations.

Because species monitoring programs listed in this table have been designed for different purposes and may track different attributes of individual species or groups of species, the existing species monitoring programs in Delaware may not all be reporting similar types of data for all species that are being tracked in the State.

Habitat Monitoring

Delaware also has numerous monitoring programs already in place that monitor various attributes of wildlife habitats, from the site-specific local level all the way up to statewide and regional levels (Appendix 5). These existing programs will be the primary means for monitoring the condition, extent, and status of wildlife habitats identified in this SWAP. Data from these programs are collected and reported to the relevant wildlife managers at the state and federal level, in order to provide information that can be used for adaptively managing these important wildlife habitats.

Because the habitat monitoring programs have been designed for different purposes and may track different attributes of individual sites or ecological communities, the existing habitat monitoring programs in Delaware may not all be reporting similar types of data for all habitats that are being tracked in the State.

Important Data Gaps in Delaware

Although limited resources prevent the monitoring of a significant number of the aspects of the natural or human environment relevant to fish and wildlife conservation efforts, it is possible to identify high-priority target areas where additional data would be helpful for developing management prescriptions for fish and wildlife species and their habitats. Chapter 1 and Chapter 4 both include the high priority data gaps identified by taxa experts, planners, and stakeholders through the DEWAP review process. Examples include taxa such as invertebrates, small mammals and fresh water nongame fish where baseline data do not exist to form the basis of a monitoring protocol. DE DNREC plans to work with partners to develop monitoring programs to address these gaps including species, taxa, habitat and community-level monitoring. This will be an important step towards providing wildlife managers in Delaware with the information they need.

Coordination with Partners

Plans and programs listed in Appendix 5 show existing monitoring efforts and tools currently used by DE DNREC DFW and its partners to assess SGCN, key habitats and related issues. Creating new programs to address the needs identified in Chapter 4, will require extensive coordination. DE DNREC will play a lead role, involving key partners and stakeholders in identifying new or expanding

current monitoring programs that can be implemented by federal, state and local governments, non-governmental organizations, universities and other partners.

The timeliest measures of success are those that directly monitor the rate of Plan implementation, but the degree to which partners integrate SGCN, key habitats and conservation actions into their plans and programs is just as important as a SWAP performance measure. To that end, each partner will receive the final DEWAP with the request that they incorporate its species and habitats into their programs and coordinate with DNREC DFW to implement appropriate conservation actions.

Effectiveness of Conservation Actions

The purpose of tracking effectiveness measures is to obtain the information needed to adaptively manage fish and wildlife species and habitats in the state. Delaware is committed to an adaptive management approach to fish and wildlife conservation. The next sections of this chapter describe a conceptual model for the WAP with corresponding results chains and illustrate how the SWG effectiveness measures function within an adaptive management context. The effectiveness of conservation actions described in this WAP will be measured using a set of standardized effectiveness measures that have been developed by AFWA and described in their 2011 *Measuring the Effectiveness of State Wildlife Grants Final Report* (AFWA 2011). Actual values for these measures will be entered into the USFWS *Wildlife TRACS* database, and comparisons of the values of these measures over time will be used to establish the degree of effectiveness of individual projects as well as broader conservation programs. Terms and standard definitions are derived from Margoluis and Salafsky (1998) and Salafsky et al. (2008).

Conceptual Model for the Delaware Wildlife Action Plan

Conceptual models are at the heart of adaptive management approaches for species and habitat conservation. Models illustrate what is called the "theory of change" for a project: the causal pathways by which managers believe that a project will achieve its desired results. Although there are many different kinds of conceptual models, Margoluis and Salafsky (1998) introduced a simple form of box-and-arrow diagram that shows causal linkages between the basic conservation elements for an individual project, including targets, threats, and conservation actions. While originally developed as a tool for developing individual conservation projects, conceptual models can also be developed for a larger conservation program. The following conceptual model for the DEWAP illustrates the linkages between the core plan elements, including species and habitats, issues and actions. This conceptual model is intended to be a generalized representation of the

interactions between the plan elements. Not all of the issues and actions shown in the diagram will apply to every species or habitat. What the diagram shows is the set of possible issues and actions that could affect a particular species or habitat.

Conservation actions are shown in yellow hexagons; issues or information needs are shown in lavender boxes, and targets are shown in blue ovals. Arrows indicate the logical causal linkages between the elements. Arrows between the elements. Arrows between actions and issues show that the action is intended to remediate or ameliorate the issue. Arrows between issues and targets show that the issue affects that target.
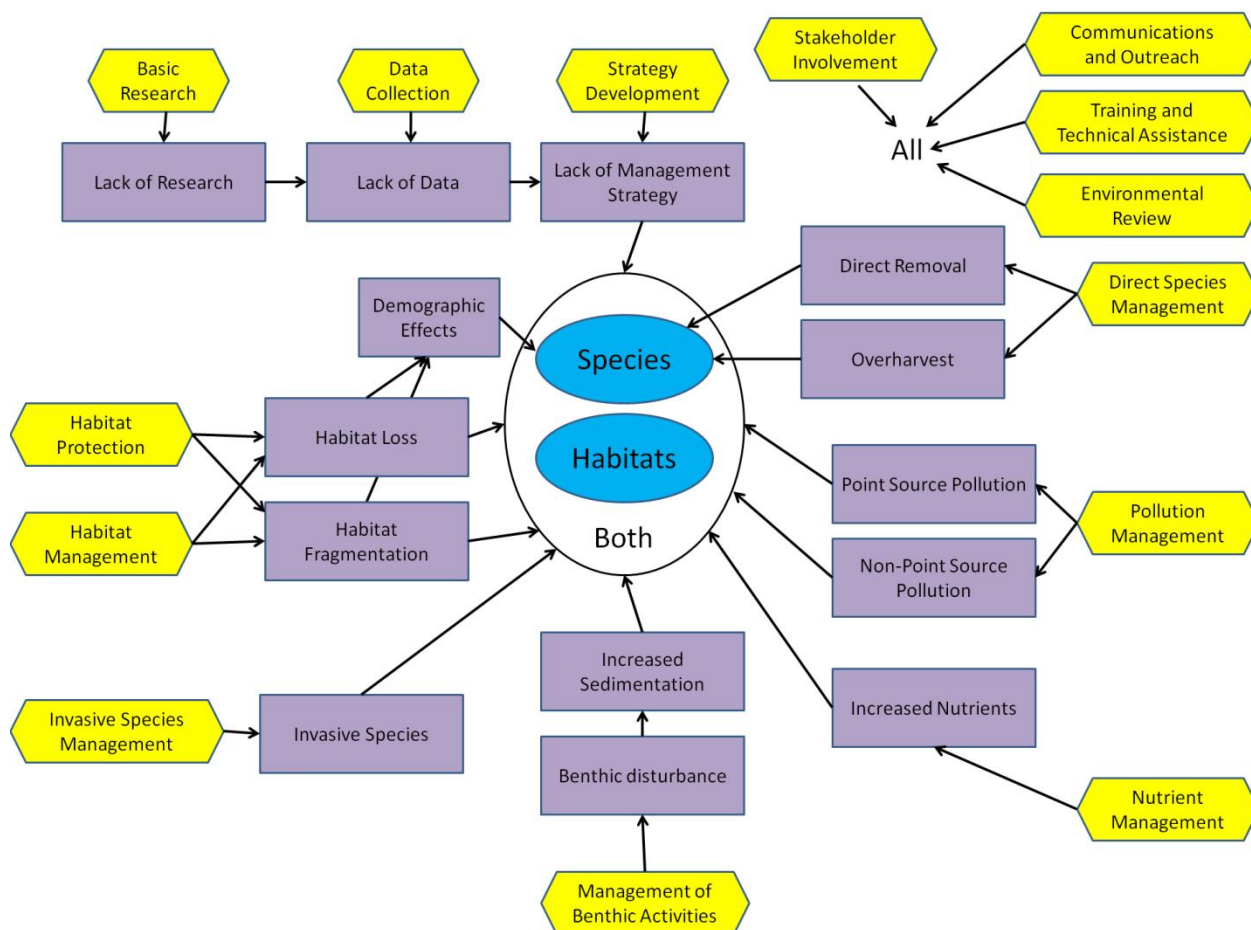
Figure 5. 1 Conceptual Model Showing Linkages between SWAP Elements

From Conceptual Model to Results Chains

The conceptual model above can be used to construct a set of results chains for each of the different conservation actions in the yellow hexagons. A results chain shows the logical linkages between a conservation action and the target that is the intended beneficiary of that action. Results chains also include issues, in cases when the conservation action is intended to reduce a specific issue, and may also include intermediate outcomes between the action and its intended benefits to the target.
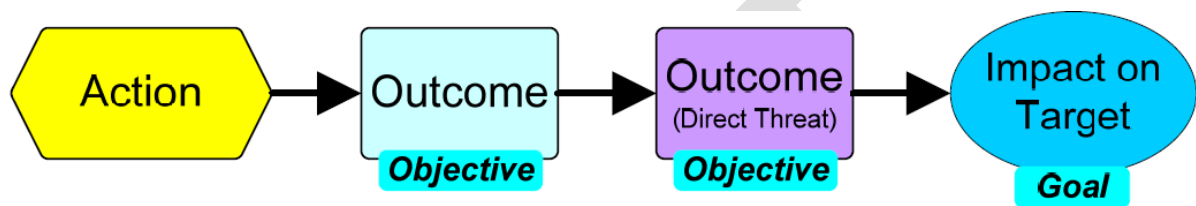

Figure 5. 2 Sample Results Chain Showing the Linkages between these Basic Elements

Fully developed results chains also incorporate indicators for each of the individual elements (e.g., action, issue, outcome, and target). A specific measure is then identified for each indicator, showing how exactly that indicator will be measured over time. Data from existing monitoring programs can be used to track the values of these measures over time. Reviewing data from monitoring programs can help managers adjust their management prescriptions and adaptively manage wildlife species and their habitats.

DE DNREC DFW and its partners will develop project-specific results chains for the individual conservation actions that are selected for implementation. At the same time, the state will be using existing results chains that have been developed by NEAFWA and AFWA to identify potential indicators and effectiveness measures for the categories of conservation actions in the conceptual model above.

Results Chains and Effectiveness Measures for Conservation Actions

Results chains were originally developed as tools for developing an individual conservation project. It is also possible to develop generalized results chains that show the relationships between the basic classes of elements (e.g., actions, issues, outcomes, and targets) for particular types or classes of conservation projects. These generalized results chains can be very helpful in identifying indicators and measures that can be used to track progress towards conservation goals across a

broader suite of similar projects. If projects are tracked using identical or compatible indicators and measures, the information about project accomplishments can then be "rolled up" across the suite of projects in order to report broader progress to funding agencies and the general public.

NEAFWA and AFWA have both developed sets of generalized results chains for common conservation actions described in the SWAPs. The AFWA report on SWG Effectiveness Measures (AFWA 2011) also included a set of recommended indicators for each of a set of generalized results chains. Because these indicators are intended to track progress on conservation projects, they are also known as "effectiveness measures" or "performance measures." Effectiveness measures will be tracked by Delaware for particular classes of conservation actions. These effectiveness measures have been developed by the AFWA SWG Effectiveness Measures Working Group (AFWA 2011) and will be reported and tracked as part of the State of Delaware's regular reporting to the USFWS via the *Wildlife TRACS* database.

Scenario: Delaware Shorebird Project- Data Collection

The following example describes a proposed approach for Delaware's framework for monitoring and effectiveness measures.

Red Knots, Mispillion Harbor, Delaware.
Credit: Gregory Breese/USFWS

Figure 5. 3 Red Knots, Mispillion Harbor, DE

Each spring, hundreds of thousands of shorebirds stop along on the shores of the Delaware Bay. The Bay is an integral rest stop for shorebirds that have traveled thousands of miles. They stop here to eat vast numbers of protein-packed horseshoe crab eggs. This provides the energy they need to continue on their journey to the breeding grounds in the Canadian Arctic. Due to various issues, the numbers of migratory shorebirds stopping in Delaware Bay have dramatically declined.

The Delaware Shorebird Project (http://www.dnrec.delaware.gov/fw/Shorebirds/Pages/default.aspx) is a team of scientists, local volunteers, researchers and bird watchers working to mitigate issues to shorebirds. Since 1997, they have researched the populations of migratory shorebirds and conducted horseshoe crab egg surveys as the primary food source for shorebirds in Delaware Bay. Their research contributes to an international network that supports and directs shorebird habitat protection and management plans (e.g., the Northern Atlantic Regional Shorebird Plan). Survey results are used to help support local and regional management efforts for both shorebirds and horseshoe crabs with key audiences including the adjacent state fish and wildlife agencies, U.S. Fish and Wildlife Service, National Marine Fisheries Service and Atlantic States Marine Fisheries Commission.
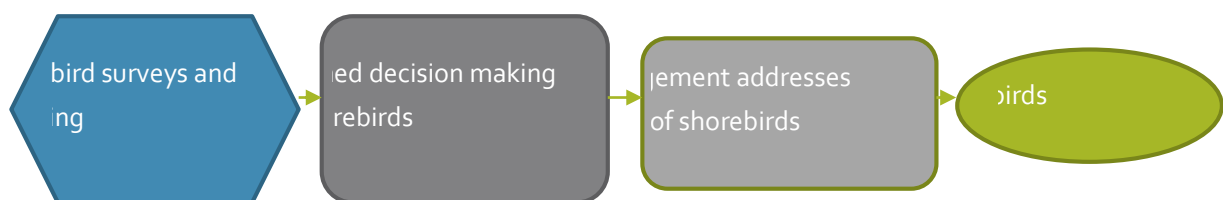
To collect and report data on shorebirds in Delaware Bay, managers identify the following specific conservation action: use surveys and reporting to make informed management decisions.

For this action, an example basic results chain (Figure 5. 3.) is developed. The diagram shows the logical connections between the four basic conservation elements: action, objectives, issues, and targets (species and/or habitats). In this case, these elements are defined as follows:

- **Action:** Use surveys to gather data on Delaware Bay shorebird species and report results to relevant partners;
- **Objective:** To make informed decisions that support shorebird populations;
- **Issue:** Management may not address needs of shorebird species; and
- **Target:** Species- shorebirds.

For each element in the results chain, an indicator and a method or measure by which that indicator will be tracked is identified.

The Association of Fish and Wildlife Agencies' 2011 report on Effectiveness Measures for State Wildlife Grants classifies surveys as a "Data Collection and Analysis." Recommended indicators and performance measures for projects that involve Data Collection and Analysis include the following:

- Evidence that clear management needs and outcomes have been identified with input from relevant data users;
- Evidence that the researcher clearly provides answers to relevant questions;
- Evidence that data are reaching relevant audiences;
- Evidence that data collection effort resulted in conservation action recommendations; and
- Evidence data are being used to inform conservation actions.

For the specific management action (shorebird surveys and reporting), the indicator "percent of Information and Data Collection Actions in which researcher provided relevant answers to questions," will be measured by tracking the reports of annual shorebird surveys completed within one year of survey completion. The data collected includes shorebird survivorship and horseshoe egg surveys. This information is very relevant and providing it in a timely manner will help ensure that management decisions will have the information to manage species based on annual fluctuations.

For the objective (Informed Decisions), the indicator data collection efforts in which data are reaching relevant audiences will be measured by tracking the number of data requests by year and audience.

For the issue (Management addresses needs of shorebird species), the indicator "percent of Information and Data Collection Actions that resulted in recommendations" will be measured by tracking the percent of shorebird management plans that cite the shorebird survey.

For the targets (shorebird species), the indicator population estimates of shorebirds using the red knot as an example can be measured.

To implement and track these indicators, managers will need to record basic information about these indicators in the DEWAP database including: the description of a specific measure for the indicator, the values of that measure in 2015 and 2025, the units for the measure, and the name of any monitoring program that provides data on that measure and indicator. Data from the database can also be reported to the USFWS, using the Wildlife TRACS database to record progress towards achievement of conservation objectives as individual projects are completed.

In 2025, managers will present the basic results chain shown above and a chart or diagram showing how the values of each indicator for the chain have changed over the years since the project was implemented. The following charts are provided as examples of how these data might be presented in the 2025 Wildlife Action Plan (Figure 5.5.).
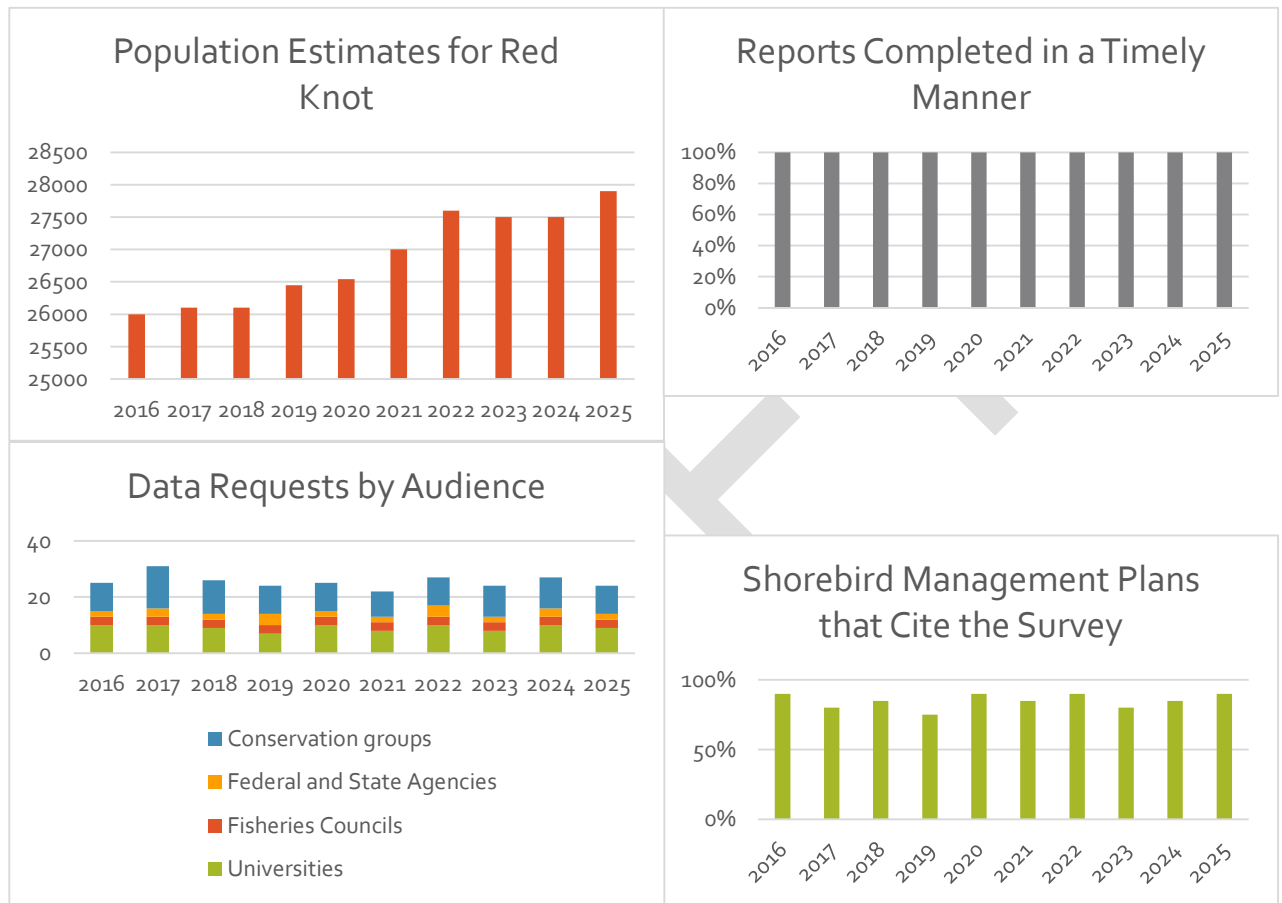
Population Estimates for Red Knot

Reports Completed in a Timely Manner

Data Requests by Audience

■ Conservation groups
■ Federal and State Agencies
■ Fisheries Councils
■ Universities

Shorebird Management Plans that Cite the Survey

Figure 5. 5 Example data to show the impact of surveys and reporting on shorebird species conservation

Taken together, these four charts graphically illustrate progress towards the conservation goals for the surveys and reporting on shorebird conservation (Figure 5. 4.). By completing reports in a timely manner, DE DNREC DFW's partners are able to incorporate the data into their management plans. In addition, audiences demonstrate continued interest in the information. The number of red knots fluctuates over time but the species overall population trend is positive, demonstrating progress towards the overall goal of conserving this species. Based on these charts, this would appear to be a

successful data collection action. These charts illustrate one way to track project effectiveness over time for this example project.

Scenario: Habitat Management for Breeding Amphibians

The following example describes a proposed approach for Delaware's framework for monitoring and effectiveness measures.


Several SGCN amphibians (spotted salamander, four-toed salamander, Cope's gray treefrog, Eastern spadefoot, tiger salamander, and barking treefrog) use coastal plain seasonal ponds to breed. Many of these ponds are threatened by degraded water quality with the loss of riparian buffers and no longer support breeding amphibians. A statewide analysis of coastal plain ponds found that about 25% of pond habitat is surrounded half or less by a forested buffer adequate for the conservation of typical pond-breeding salamanders; less than 20% is completely surrounded by such a buffer.

Priority conservation actions that have been identified to improve the conservation of breeding amphibians and their aquatic habitat include: (1) support implementation of more natural flow regimes and full compliance with water quality standards; (2) improve water and habitat quality by supporting riparian habitat restoration projects; and (3) preserve adjacent contiguous forested habitats. Key partners to implement these conservation actions include the USFWS, Natural Resources Conservation Service (NRCS), DNREC's Ambient Surface Water Quality Monitoring Program, Delaware Center for Inlands Bays, Delaware Nature Society and private land owners.

In this example, DE DNREC DFW, NRCS and private land managers in Delaware identify the following specific conservation action: plant riparian buffers to improve water quality, to help make the habitat more suitable for breeding amphibians.

For this action, this example basic results chain (Figure 5-5.), a diagram which shows the logical connections between the four basic conservation elements is developed: action, objectives, issues, and targets (species and habitats). In this case, these elements are defined as follows:

- **Action:** Plant riparian buffers by planting vegetation along coastal ponds;
- **Objective:** Restore riparian buffers to improve water quality in support of breeding amphibian populations;
- **Issue:** Nitrates from land uses near the ponds result in poor water quality; and
- **Targets:** Habitat- coastal ponds, Species- breeding amphibians.
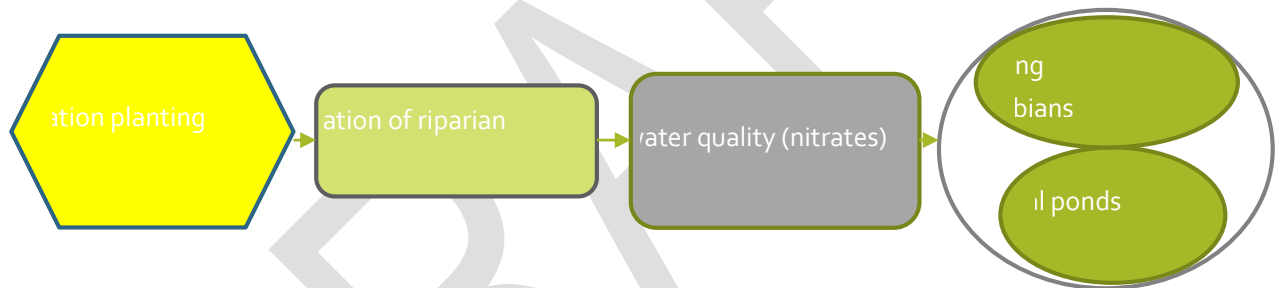
For each element in the results chain, an indicator and a method or measure by which that indicator will be tracked is identified.

AFWA's 2011 report on effectiveness measures for SWGs classifies restoring riparian buffers as a "Direct Management of Natural Resources." Recommended indicators and performance measures for projects that involve Direct Management of Natural Resources include the following:

- Percent Management Actions Implemented As Planned;
- Evidence that Direct Management Action is Reducing Key Issues;
- Degree to which target SGCNs respond as expected from direct management actions;

- Degree to which target habitats/processes respond as expected from direct management actions;
- Species Measures (e.g., population size, reproductive success); and
- Habitat Measures (e.g., size, condition).

For the specific management action (vegetation planting), the indicator "ponds that have received riparian buffer restoration," will be measured by tracking the number of ponds that are subjected to vegetation planting each year.
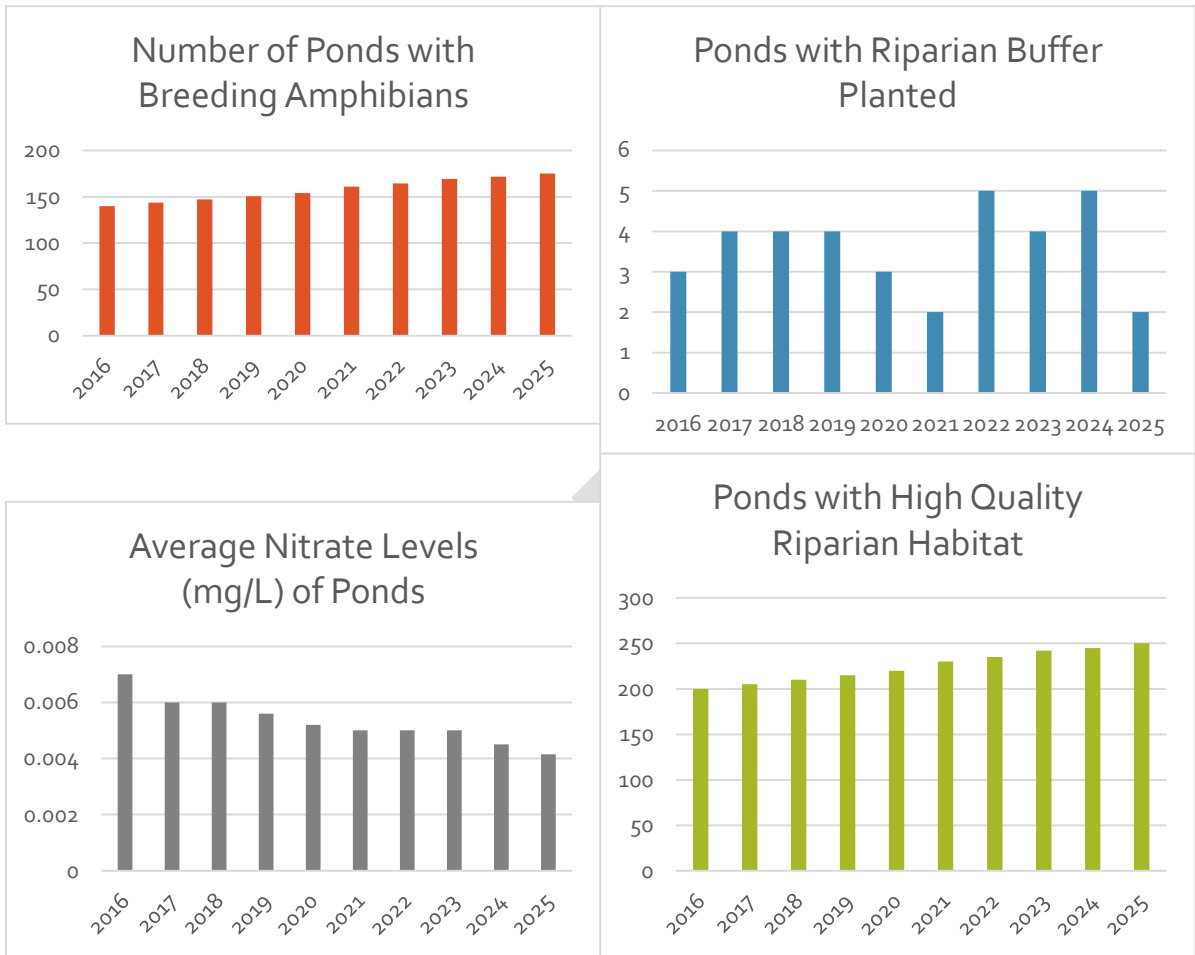
For the objective (restoration of riparian buffer), the indicator "ponds that have sufficient riparian buffer," will be measured by tracking the ponds meeting certain vegetation requirements (NRCS 2015).

For the issue (poor water quality – nitrate levels), the indicator "average nitrate levels of ponds" will be measured by tracking water quality through DNREC's Ambient Surface Water Quality Monitoring Program, Delaware Center for Inlands Bays, and Delaware Nature Society monitoring efforts.

For the targets (coastal ponds), the indicators "number of ponds with breeding amphibian populations" and "ponds with high quality coastal pond habitat" can be measured. The indicator for the breeding amphibian populations will be measured using egg mass surveys conducted. High quality riparian habitat will be tracked by the same measures used to track habitat condition (chapter 4).

To implement and track these indicators, managers will record basic information about these indicators including: the description of a specific measure for the indicator, the values of that measure in 2015 and 2025, the units for the measure, and the name of any monitoring program that provides data on that measure and indicator. Data can also be reported to the USFWS, using the *Wildlife TRACS* database to record progress towards achievement of conservation objectives as individual projects are completed.

In 2025, the basic results chain shown above and a chart or diagram will show how the values of each indicator for the chain have changed over the years since the project was implemented. The following charts (Figure 5-6.) are provided as examples of how these data might be presented in the 2025 DEWAP.

Number of Ponds with Breeding Amphibians

Ponds with Riparian Buffer Planted

Average Nitrate Levels (mg/L) of Ponds

Ponds with High Quality Riparian Habitat

These four charts graphically illustrate progress towards the conservation goals for coastal pond riparian habitats and the breeding amphibian populations. By restoring riparian buffers for a relatively small number of ponds each year, the water quality greatly improves (decreases nitrate levels) over ten years, and the number of ponds with high quality riparian habitat is increased. The number of ponds occupied by breeding amphibians also increases over time, demonstrating progress towards the overall goal of conserving this suite of species in the state. Based on these charts, this would appear to be a successful conservation management action. These charts illustrate one way to track and report project effectiveness over time for this example project.

This adaptive management approach will allow DE DNREC DFW to not only quantify these performance measures, but also compare the results of the species monitoring to infer whether the conservation actions are improving the breeding amphibian populations each year. If breeding amphibians show no significant improvement, then the conservation actions can be modified to intensify habitat protection measures, or target key areas and cooperative projects with partners. Tracking indicators and effectiveness measures will put Delaware in an excellent position to show the effectiveness of DEWAP implementation efforts in the future.

Adaptive Management Cycle

Delaware is committed to an adaptive management approach to fish and wildlife conservation and will track effectiveness measures in order to obtain the information necessary to do so. Adaptive management of SGCN, key habitats, and conservation issues will be facilitated primarily through regular progress reviews by the Core Team. This process can be visualized as follows:

Implementation and validation performance indicators for measuring success are shown in the following table, organized by the Plan's Guiding Principles for Conservation Actions as outlined in Table 5.2. Once a decision support application is in place, information on all of these indicators may be collected initially. However, it is anticipated that, with experience, a subset will be selected that best measures the effectiveness of the Plan as a whole. Implementation indicators are measures of overall Plan success, and validation indicators are applied across all conservation actions. On the other hand, effectiveness indicators are specific to individual actions, and will be developed as actions are employed; a few examples of these are detailed in Table 5-5. Also, any indicator may require modification over time, or additional indicators may need development if entirely new conservation actions arise as part of an adaptive management approach.

Table 5. 2 Guiding Principles and Performance Indicators for Conservation Actions

Guiding Principle for Conservation Actions	Implementation Performance Indicators
Management on Conservation Lands – Direct management in state wildlife areas – and state parks and state forests in keeping with their primary missions – towards key habitats and SGCN in the Green Infrastructure (GI) Natural Resources Focus Area, in order to protect and restore habitats and species, and to abate the impacts of conservation issues. Encourage Federal and NGO land managers to focus on this same objective.	• # of acres/miles of viable key habitats protected or restored in managed areas in GI Natural Resources Focus Area • # of managed area plans incorporating conservation actions in GI Natural Resources Focus Area
Management on Private Lands – Direct private lands management towards buffering and connecting conservation lands in the Green Infrastructure Natural Resources Focus Area, and towards protecting outlying small patch habitats and SGCN.	• # of landowners enrolled in conservation programs in GI Natural Resources Focus Area • # of acres/miles of key habitats protected or restored in GI Natural Resources Focus Area • # of dollars appropriated or spent for incentive programs in GI Natural Resources Focus Area • # of turnkey services developed
Measures of Success, Monitoring, Research and Adaptive Management – Establish performance indicators to measure the success of conservation actions and plan implementation. Monitor species, habitats and impacts of conservation issues, and conduct applied research, so as to facilitate adaptive management.	• % of conservation actions initiated or completed by DFW • # of standardized monitoring protocols developed • # of specific performance indicators developed • # of management plans incorporating adaptive management framework • Scorecard developed or updated
Data Collection and Information Management – Collect, manage and analyze data to support wildlife diversity conservation efforts with sound science.	• # of spatial database applications for decision support installed or updated • # of users of decision support applications • # of agencies and organizations incorporating SGCN and key habitat data into decision making

Guiding Principle for Conservation Actions	Implementation Performance Indicators
Division Operations – Reorganize, revise and/or enhance DFW administrative structure, staffing, budgeting, procedures and practices as necessary to facilitate implementation of the DEWAP.	• % of known species with current Natural Heritage ranks • % of SGCN and key habitats with current distribution and status/condition information • # of standardized or compatible ecological classification systems developed • # of risk assessments initiated or completed for "direct threat" conservation issues • # of management plans initiated or completed for SGCN, key habitat and "direct threat" conservation issues • # of research projects initiated or completed • # of hours of DFW staff time devoted to SGCN and key habitat conservation • # of dollars of State and Federal funding appropriated or spent for SGCN and key habitat conservation
Partnership Development – Strengthen partnerships with other conservation agencies and organizations to link landscapes, tie together complementary approaches, and leverage investments of time, staff and money.	• # of hours of partner staff time devoted to SGCN and key habitat conservation • # of dollars of partner funding appropriated or spent for SGCN and key habitat conservation • # of conservation actions initiated or completed by partners

Guiding Principle for Conservation Actions	Implementation Performance Indicators
Education, Outreach and Enforcement – Increase public knowledge of wildlife conservation issues to develop an understanding of habitats, SGCN, and conservation issues and actions; foster a sense of responsibility for personal choices; actively engage citizens in conserving natural resources; and otherwise cultivate support for wildlife diversity conservation. Enforce regulations to promote responsible behavior in interactions with wildlife.	• # of State staff trained on key habitat ecology, SGCN biology, and conservation issues and actions • # of "profile brochures," "citizens guides" and wildlife viewing guides initiated or completed • # of Adopt-a-Wetland and Backyard Habitat participants • # of Certified Citizen Naturalists • # of schoolyard habitats initiated or completed • # of enforcement actions pertaining to SGCN and key habitats • # of hours of DFW staff time devoted to enforcement of regulations protecting SGCN and key habitats

Guiding Principle for Conservation Actions	Validation Performance Indicators
Conservation of Species *vs*. Habitats – Target the preservation or restoration of SGCN, but emphasize the management of ecological structure and function of key habitats over management of individual species.	• # of viable SGCN occurrences, or SGCN population levels • # of species added to or removed from SGCN list or State endangered list, or with changed Heritage rank • # of acres/miles of viable key habitats

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